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No. 2

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Ad Hoc Report in related fields published during October 1976

ENGINEERING: JPRS 68034-1 and-2, ALBUM OF BLUEPRINTS OF STRUCTURES AND MEMBERS OF INDUSTRIAL BUILDINGS (Second Edition, Revised and Supplemented) Textbook by associate professor and candidate of technical sciences R. I. Trepenenkov. Part I, 263 pages. Part II, 179 pages. 7 October 1976

CHEMISTRY

LYSINE FROM WOOD: NEW SOURCE OF AMINO ACID FOOD

Leningrad LENINGRADSKAYA PRAVDA in Russian 12 Aug 76 p 4

[Article by Doctor of Chemical Sceinces L. Dmitrenko, director of VNIIGidroliz]

[Text] An experimental batch of a new food preparation -- lysine from wood -- was produced at the All-Union Scientific Production Association "Gidrolizprom."

Specialists of the association in cooperation with institutes of the USSR Academy of Sciences and the Latvian Academy of Sciences developed a method for obtaining a new concentrate which makes it possible to obtain about 300 kilograms of a dry food product from 1 ton of wood with a lysine content of up to 15 percent.

Lysine is an indispensable amino acid. It is used widely in the food and medical industries, as well as in animal husbandry, for increasing the nutritive value of food. Its deficiency in the food rations of animals and man makes it impossible to assimilate fully all amino acids entering the organism.

Up to the present time, this product has been obtained from molasses, which is a valuable food for animals. Moreover, it is practically impossible to produce lysine in a dry form on this basis because of certain properties of molasses. By using wood hydrolysates, it is possible to obtain a good-quality product in a dry form.

10,233
CSO:1870

REVIEW OF SOVIET KILLER SATELLITE PROGRAM

Paris L'AERONAUTIQUE ET L'ASTRONAUTIQUE in French Jul-Aug 76
pp 29-35

/Article by Didier Laurent/

/Text/ Soviet Space Defense

After presenting the purpose of space defense, the potential role of satellites in such defense systems, and the maneuvers to be performed by space defense satellites for interception or survey operation, the various interception tests carried out by the Soviet Union within the scope of the Cosmos program are reviewed and discussed. An evaluation of the stage of advancement reached by the Soviet Union in the field of interception and survey satellites is then attempted.

With its launching of Cosmos 752 on 24 July 1975, Cosmos 803, 804, and 814 on 12 February, 16 February, and 13 April, and Cosmos 816 on 28 April, the Soviet Union has resumed the tests of its interception and perhaps inspection (or survey) satellite system, which had been interrupted for 3 years.

Now that this program, which was thought to have been dropped, is being revived, it seems of use to review the program. After discussing the purpose of space defense, the role that satellites can play in this defense system, and the maneuvers that space defense satellites must perform to carry out an interception or inspection, we will review and analyze the various interception tests that the Soviet Union has conducted within the Cosmos program, and we will attempt to evaluate their degree of advancement in the field of interception and inspection satellites.

Space Defense

A nation's space defense system requires it to use whatever methods it possesses to prevent other nations from using space for military purposes. These methods may obviously be offensive, but they may also be defensive or support methods.

At the present time, and probably for some time in the future, spacecraft used for military purposes will be satellites, often unmanned, orbiting relatively close to the earth; these satellites may have independent but limited propulsion systems, enabling them to modify the characteristics of their orbit, but generally without significant orbital changes.

There are three types of spacecraft which may pose a military threat; depending on their primary mission, they are:

> Offensive spacecraft, which carry nuclear weapons to destroy targets on the surface of the earth: bombing satellites and orbital bombs only traveling a fraction of an orbit (FOBS);
>
> Defensive spacecraft, designed to detect, possibly inspect, and prevent strategic missiles and military spacecraft from completing their mission: inspection and interception satellites.
>
> Support spacecraft, which may provide support for armed forces combat operations taking place on the earth's surface: photographic or electronic reconnaissance satellites, weather, geodetic, cartographic, navigation, traffic control, communications satellites, etc.

Manned orbiting stations which may be used for both military and civilian purposes should be added to this list.

Space defense requires the capability of:

> Detecting the appearance of new spacecraft in space;
>
> Identifying their mission or missions;
>
> Preventing them from carrying out their mission if the mission is hostile or troublesome.

At the present time, there are several thousand objects in orbit around the earth. Reliably detecting the appearance of a new satellite requires that a constantly updated, detailed inventory of all the objects in orbit around the earth be maintained (not only satellites themselves, but also their carrier rockets and other objects abandoned in space) and that their orbit be tracked continually.

To identify a spacecraft's missions, it is not enough just to detect its presence and determine its orbital parameters. Its shape, size, mass, volume, equipment, weapons, etc. must be known, and with as much precision as possible.

When identification of a spacecraft reveals that it does indeed constitute a threat, it should be prevented from carrying out its mission. This may be done by quite diverse methods, depending on the type of satellite and the type of mission. It is best not to simply destroy a spacecraft, except as a last resort, for such destruction may considerably complicate the monitoring of the space situation, because of the many fragments which will continue in orbit.

The Use of Satellites for Space Defense

Earth-based systems can be used to perform space defense operations, but in addition, satellites may be used, receiving varying degrees of support from earth.

Satellites can be used to detect other satellites. For example, a satellite with radar and a computer containing in its memory bank the orbital parameters of all the bodies known to be in orbit around the earth, can detect the appearance of a new satellite by comparing the orbital parameters of a satellite determined by its radar measurements with the orbital parameters stored in its computer memory.

Satellites can also be used to identify other satellites. For example:

> A satellite with television equipment can transmit to earth images of the spacecraft it is examining, thus giving precise data on its shape and size.
>
> A satellite can determine the mass of an unknown satellite by sending a blast of gas at the unknown satellite, and then measuring the acceleration caused by this blast of gas.

A satellite with a radiation detector can determine whether a spacecraft is carrying a nuclear device.

In addition, satellites can be used to annihilate the threat caused by other satellites, as follows:

By destroying these satellites by explosion, by the use of space missiles or by the emission of particles along its orbit;

By "locking on" to these satellites, causing them to re-enter and burn up in the dense layers of the atmosphere;

By neutralizing their optical or infrared equipment by luminous or thermal emissions;

By jamming radio communications between the satellites and their remote control station.

Obviously, this list is by no means exhaustive.

Maneuvers to be Performed for an Interception or Inspection

The use of satellites for space defense presupposes the capability of bringing a satellite into the immediate proximity of another satellite, thus performing an interception, and in some cases -- when making an actual inspection -- achieving rendez-vous. To achieve rendez-vous, in addition to the interception itself, at the moment of interception the relative velocity of the killer satellite in relation to the target must be zero. This may require a final modification of the velocity vector of the killer, both in magnitude and in direction.

The interception operation may be attempted either by a satellite on ground alert on its launch vehicle, or by a satellite already in orbit.

Satellite on Ground Alert

The problem lies in placing the satellite on ground alert in an orbit with at least one point in common with the orbit of the target satellite, proceeding so that the killer satellite and the target will pass this point, the selected point of interception, at the same time.

Whatever the location of the launch point of the killer satellite and the position of the target at the time of launch of the killer, an interception is always theoretically possible. The point of interception must be selected so that the angle of inclination to the equator of the plane formed by the center of the earth, the point of injection of the killer into its orbit, and the point of interception will be equal to or greater than the latitude of the point of injection of the killer. Then, at the moment of injection into orbit, the velocity vector of the killer must be in the plane which has just been defined, and the direction and magnitude must be such that the killer satellite and the target will pass the selected point of interception at the same time. The killer satellite may be launched at any time, and the interception may occur within a short time, generally less than the target's period of revolution.

Considering the precision of injection now possible, this method of operation causes the pass distances to increase as the angle formed by the planes of orbit of the killer and the target become larger. To improve the precision of interception, the obvious solution is to orbit the killer in the same plane as the target; that is, to launch the killer so that, at the instant of its injection into orbit, the killer (and its velocity vector) will be in the orbital plane of the target. In this case:

> The killer can only be launched within a restricted region of latitude, since the latitude of the point of injection of the killer can not be greater than the angle of inclination of the target's orbital plane over the equator.
>
> For a launch point satisfying this latitude condition, the launch can only be made twice in each 24-hour period during very short time intervals (launch windows).
>
> The interception interval -- that is, the time elapsing between the moment when the decision to intercept is made and the instant when it takes place -- is long.

When the killer satellite's injection is not precise enough to obtain a suitable pass distance, the killer's orbit must be corrected.

Satellites Already in Orbit

To intercept a satellite already in orbit, the killer satellite's orbital plane is changed to bring it into the orbital plane of the target; then the killer's orbit is changed again, but this time in the target's orbital plane.

The maneuvers that must be completed to carry out an interception or, an even more difficult procedure, a rendez-vous, require that the killer satellite or the last stage of its carrier rocket be equipped with reignitable engines to achieve precise control of the magnitude and direction of velocity. The amount of propellants needed to make these orbital changes depends on the mass of the body in orbit and on the nature of the maneuver -- the variation in velocity needed to perform the maneuver. As an example, take a satellite in a circular orbit at an altitude of 500 km. A variation in velocity of 1335, 2665, or 4,000 m/s is needed to obtain a change in the orbital plane of 10°, 20°, or 30°, while it takes only a variation in velocity of 120, 230, or 330 m/s for an orbit with an apogee of 1000, 1500, or 2000 km in the same plane.

These engines must also be controled in accordance with the positions and movements of the target and the killer. For just a simple interception, guidance can be by remote control from the ground, based on data supplied by tracking equipment on the ground. For an identification, requiring the killer to pass within 15-30 m of the target, or especially for a rendez-vous, there must be terminal guidance controlled from the ground based on data supplied by a tracking device carried on the killer satellite or an automatic guidance system, using a homing device.

Soviet Space Testing of Interception and/or Inspection Satellites

Several times since the end of 1968, Western tracking networks have detected Soviet satellites of the Cosmos series making a pass near other satellites, also of the Cosmos series, which were placed in orbit several days previously. Shortly after this pass, the first satellites were destroyed or were recovered on the ground. (See Table 1).

The Tass Agency has never officially released these facts. As usual, Tass just announced that these satellite launches were part of the ongoing space exploration program.

However, there is reason to believe that these shots were actually part of a special interception and/or inspection satellite flight testing program. So far, we can discern two phases in this program.

1 No des Cosmos	Mission	Date	LANCEMENT 2 Hre GMT	3 Lieu	Apogée (km)	Perigée (km)	Incli-naison 4 (0)	Période 5 (mn)	6 Rapprochement maximal Date	7 Hre GMT	OBSERVATIONS 8
248	9 cible	19-10-1968	4 h 20 mn	11 [illegible]atam	551	490	62,3	94,8			
249	chasseur	20-10-1968	4 h 05 mn	[illegible]atam	2177	514	62,4	112,2	20-10-1968	7 h 40 mn	Détruit par explosion 12
252	chasseur 10	01-11-1968	0 h	Tiouratam	2172	538	61,9	112,5	01-11-1968	4 h 40 mn	Détruit par explosion
373	cible	20-10-1970	5 h 50 mn	Tiouratam	553	490	62,9	94,8			
374	chasseur	23-10-1970	4 h 20 mn	Tiouratam	2153	531	63,0	112,3	23-10-1970	8 h 10 mn	Détruit par explosion
375	chasseur	30-10-1970	2 h 10 mn	Tiouratam	2164	538	63,0	112,4	30-10-1970	6 h	Détruit par explosion
394	cible	09-02-1971	19 h	Plesetsk	619	574	65,9	96,5			
397	chasseur	25-02-1971	11 h 45 mn	Tiouratam	2137	593	65,8	114,7	25-02-1971	14 h 25 mn	Détruit par explosion
400	cible	18-03-1971	22 h 50 mn	Plesetsk	1016	995	65,8	105			
404	chasseur	04-04-1971	14 h 25 mn	Tiouratam	1009	811	65,9	103	04-04-1971	15 h 10 mn	Détruit à la rentrée 13
459	cible	29-11-1971	17 h 30 mn	Plesetsk	277	226	65,8	89,4			
462	chasseur	03-12-1971	13 h 10 mn	Tiouratam	1840	237	65,8	105,7	03-12-9171	16 h 50 mn	Détruit par explosion
803	cible	12-02-1976		Plesetsk	624	554	66,0	96,4			
804	chasseur	16-02-1976	8 h 27.6 mn	Tiouratam	620	528	65,74		16-02-1976	16 h 19 mn	Récupéré au sol 14
814	chasseur	13-04-1976		Tiouratam							Récupéré au sol

Table 1: Interception and/or inspection exercises conducted by the Soviets. (The orbital parameters listed are approximately those of the targets and killers at the time of their closest pass).

Key:

1. Designation
2. Launch time (GMT)
3. Launch site
4. Orbital inclination (o)
5. Orbital period
6. Closest pass
7. Time (GMT)
8. Remarks
9. Target
10. Killer satellite
11. Tyuratam
12. Destroyed by explosion
13. Destroyed upon re-entry
14. Recovered on the ground

First Phase (End of 1968 to End of 1971)

During the first phase, there were five exercises, each with one or two interceptions (seven in all).

Cosmos 248, 249, and 252

Cosmos 248, launched from Tyuratam on 19 October 1968 at 0420 GMT, was first placed in an elliptical orbit with a low perigee

(A: 462 km, P: 237 km, i: 62.3°). It was then transferred to a low excentricity orbit at an altitude of approximately 500 km (A: 551 km, P: 490 km, i: 62.3°, T: 94.8 mn), which was announced by the Tass Agency[1]. On 20 October 1968 at 0225 GMT, it was in an orbit with very similar characteristics (A: 543 km, P: 475 km, i: 62.25°, T: 94.80 mn, ω : 296°)[1].

Cosmos 249, launched from Tyuratam on 20 October 1968 at 0405 GMT, was first placed, after separation from its carrier rocket, in a low orbit with a very low perigee (A: 254 km, P: 151 km, i: 62.4°). It was then transferred to an elongated elliptical orbit (A: 2177 km, P: 514 km, i: 62.4°, T: 112.2 mn), which was announced by the Tass Agency. On 20 October 1968 at 0740 GMT, Cosmos 249 made a pass near Cosmos 248. At this moment, Cosmos 249 was in the immediate vicinity of the perigee of its orbit, in a region where its orbit was practically tangential to the orbit of Cosmos 248. After this nearby pass, Cosmos 249 exploded. On 21 October 1968 at 2135 GMT, the main debris was in an orbit with very similar characteristics (A: 2157 km, P: 493 km, i: 62.35°, T: 112.13 mn, ω : 76°).

Cosmos 252, launched from Tyuratam on 1 November 1968 at 0000 GMT, was placed, either directly or indirectly, in an elongated elliptical orbit (A: 2172 km, P: 538 km, i: 61.9°, T: 112.5 mn), which was announced by the Tass Agency. On 1 November 1968 at 0440 GMT, Cosmos 252 made a pass near Cosmos 248. At this moment, Cosmos 252 was in the immediate vicinity of the perigee of its orbit, in a region where its orbit was practically tangential to the orbit of Cosmos 248. After this nearby pass, Cosmos 252 exploded. On 8 November 1968, the main debris was in an orbit with very similar characteristics (A: 2149 km, P: 531 km, i: 62.32°, T: 112.45 mn, ω : 75°).

Cosmos 373, 374, and 375

Cosmos 373, launched from Tyuratam on 20 October 1970 at 0550 GMT, was first placed in a low perigee orbit; it abandoned

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1. The orbital parameters are indicated by the following letters: A: apogee; P: perigee; i: plane of orbital inclination over the equatorial plane; T: period of revolution; ω : argument of perigee.
   The errors in the parameters measured by western tracking networks may be as high as 5 km for apogee and perigee altitudes, 0.03° for the angle of inclination, 0.02 mn for the period of revolution, and 3° for the argument of perigee. The accuracy of the parameters released by Tass is unknown.

the last stage of its rocket in this orbit. (The orbital characteristics of this stage on 23 October 1970 at 0405 GMT were: A: 937 km, P: 145 km, i: 62.26°, T: 95.45 mn, ω : 54°). It was then transferred to a higher orbit (A: 1102 km, P: 510 km, i: 62.9°), and later brought to a low excentricity orbit near 500 km (A: 553 km, P: 490 km, i: 62.9°, T: 94.8 mn which was announced by the Tass Agency. It seems that this orbit was modified later, because of the differences between the parameters measured on 20 October 1970 at 1200 GMT (A: 544 km, P: 472 km, i: 62.93°, T: 94.77 mn, ω : 290°), and the parameters on 31 October 1970 at 0225 GMT (A: 556 km, P: 466 km, i: 62.92°, T: 94.83 mn, ω : 311°).

Cosmos 374, launched from Tyuratam on 23 October 1970 at 0420 GMT, was first placed in an elliptical orbit (A: 1053 km, P: 530 km, i: 62.9°). It was then transferred by the last stage of its carrier rocket, from which it then separated, to a more elongated elliptical orbit (A: 2153 km, P: 531 km, i: 63.0°, T: 112.3 mn), which was announced by the Tass Agency. On 23 October 1970 at 0810 GMT, Cosmos 374 made a pass near Cosmos 373. At this moment, Cosmos 374 was in the immediate vicinity of the perigee of its orbit, in a region where its orbit was practically tangential to the orbit of Cosmos 373. After this nearby pass, Cosmos 374 exploded. On 30 October 1970, the main debris was in an orbit with very similar characteristics (A: 2141 km, P: 521 km, i: 62.95°, T: 112.16 mn, ω : 61°).

Cosmos 375, launched from Tyuratam on 30 October 1970 at 0210 GMT, was first placed in an elliptical orbit (A close to 1000 km, P close to 500 km, i: 63°). It was then transferred by the last stage of its carrier rocket, from which it then separated, to a more elongated elliptical orbit (A: 2164 km, P: 538 km, i: 63.0°, T: 112.4 mn), which was announced by the Tass Agency. On 30 October 1970 at 0600 GMT, Cosmos 375 made a pass near Cosmos 373. At this moment, Cosmos 375 was in the immediate vicinity of the perigee of its orbit, in a region where its orbit was practically tangential to the orbit of Cosmos 373. After this nearby pass, Cosmos 375 exploded. On 3 November 1970 at 0000 GMT, the main debris was in an orbit with very similar characteristics (A: 2098 km, P: 524 km, i: 62.82°, T: 111.82 mn, ω : 56°).

Cosmos 394 and 397

Cosmos 394, launched from Plesetsk on 9 February 1971 at 1900 GMT, was placed, either directly or indirectly, by the last stage of its carrier rocket, from which it then

separated, in a low excentricity orbit near 600 km (A: 619 km, P: 574 km, i: 65.9°, T: 96.5 mn), which was announced by the Tass Agency. On 12 February 1971 at 0450 GMT, it was in an orbit with very similar characteristics (A: 614 km, P: 572 km, i: 65.84°, T: 96.54 mn, ω : 352°).

Cosmos 397, launched from Tyuratam on 25 February 1971 at 1145 GMT, was first placed by its carrier rocket from which it then separated in an elliptical orbit with a very low perigee (A: 664 km, P: 134 km). It was then transferred to an elongated elliptical orbit (A: 2137 km, P: 593 km, i: 65.8°, T: 114.7 mn), which was announced by the Tass Agency. On 25 February 1971 at 1425 GMT, Cosmos 397 made a pass near Cosmos 394. At this moment, Cosmos 397 was in the immediate vicinity of the perigee of its orbit, in a region where its orbit was practically tangential to the orbit of Cosmos 394. After this nearby pass, Cosmos 397 exploded. On 6 March 1971, the main debris was in an orbit with somewhat similar characteristics (A: 2202 km, P: 574 km, i: 65.73°, T: 113.51 mn, ω : 47°).

Cosmos 400 and 404

Cosmos 400, launched from Plesetsk on 18 March 1971 at 2250 GMT, was placed, either directly or indirectly, by the last stage of its carrier rocket, from which it then separated, in a low excentricity orbit at approximately 1000 km (A: 1016 km, P: 995 km, i: 65.8°, T: 105 mn), which was announced by the Tass Agency. On 20 March 1971 at 0710 GMT, it was in an orbit with very similar characteristics (A: 1006 km, P: 983 km, i: 65.83°, T: 104.99 mn, ω : 267°).

Cosmos 404, launched from Tyuratam on 4 April 1971 at 1425 GMT, was first placed, either directly or indirectly, in a low excentricity orbit (A: 1009 km, P: 811 km, i: 65.9°, T: 103 mn), which was announced by the Tass Agency. On 4 April 1971 at 1510 GMT, Cosmos 404 made a pass near Cosmos 400. At this moment, Cosmos 404 was in the immediate vicinity of the apogee of its orbit, in a region where its orbit was practically tangential to the orbit of Cosmos 400. After this nearby pass, Cosmos 404 did not explode, but was brought back by its carrier rocket from which it then separated, to a low perigee elliptical orbit. On 5 April 1971 at 0935 GMT, the characteristics of this orbit were: A: 799 km, P: 169 km, i: 65.15°, T: 94.82 mn, ω: 50°). It then burned up in the dense layers of the atmosphere.

Cosmos 459 and 462

Cosmos 459, launched from Plesetsk on 29 November 1971 at 1730 GMT, was placed by the last stage of its carrier rocket from which it then separated, in a low orbit (A: 277 km, P: 226 km,

i: 65.8°, T: 89.4 mn), which was announced by the Tass Agency. On 30 November 1971 at 0450 GMT, it was in an orbit with very similar characteristics (A: 259 km, P: 235 km, i: 65.82°, T: 89.43 mn, ω : 320°).

Cosmos 462, launched from Tyuratam on 3 December 1971 at 1310 GMT, was placed, either directly or indirectly, by the last stage of its carrier rocket from which it then separated, in an elongated elliptical orbit with a low perigee (A: 1840 km, P: 237 km, i: 65.8°, T: 105.7 mn), which was announced by the Tass Agency. On 3 December 1971 at 1650 GMT, Cosmos 462 made a pass near Cosmos 459. At this moment, Cosmos 462 was in the immediate vicinity of the perigee of its orbit, in a region where its orbit was practically tangent to the orbit of Cosmos 459. After this nearby pass, Cosmos 462 exploded. On 5 December 1971 at 2150 GMT, the main debris was in an orbit with very similar characteristics (A: 1800 km, P: 230 km, i: 65.75°, T: 105.43 mn, ω : 53°).

These experiments were quite probably interception exercises. A satellite pass near another satellite could not have been accidental, since during each experiment, the satellite launched later was placed in an orbit practically coplanar with the orbit of the satellite launched first. And in most cases, the nearby pass followed a change in orbit. The silence maintained by Tass about the missions of the satellites participating in the experiments, about their maneuvers, and about the destruction of the satellites which made these nearby pass maneuvers, leaves us with no doubt about the military nature of these experiments.

In these exercises, we may consider the satellite launched first as the target, and the second or third satellite(s) as the killer(s). The satellites launched first traveled in practically circular orbits at altitudes on the order of 250, 500, 600, and 1000 kms, which are altitudes generally used by Soviet military satellites. Most of the second or third satellites made orbital changes, placing them in more excentric orbits, modifying their periods of revolution, thus reducing their angular deviation in relation to the satellites launched first. Also, the second or third satellites in the exercises were destroyed. This suggests that the Soviets wanted to prevent foreign intelligence services from examining the satellites which played an active role as killer satellites in these experiments.

If we consider all these exercises, we find a certain number of common features which could not have been caused by chance.

The targets were placed in almost circular orbits, with too significant a variation in apogee and perigee altitudes (generally on the order of 50-60 kms) to have been unintentional.

The arguments of perigee of the targets' orbits were in the 270°-360° sector.

The perigees of the killer satellites' orbits were intermediate between the perigee and apogee of the targets' orbits (except for Cosmos 404, where this was true for the apogee).

The arguments of perigee of the killers' orbits, all launched from Tyuratam, were in the 50°-75° sector.

The variation between the inclination of the targets' orbits and the killers' orbits was small, generally less than 0.1°.

The passes took placed in the immediate vicinity of the perigee of the killers' orbit (except for Cosmos 404, where it took place in the vicinity of the apogee).

The passes were made rapidly, less than three revolutions after the killers were placed in orbit.

To get an idea of the way in which the Soviets performed these interceptions, the most useful experiment is the interception of Cosmos 459 by Cosmos 462, an interception which was apparently performed without correction, at least without any detectable correction, of the killer's original orbit.

We find that the orbits of the target and the killer were practically coplanar, that their major axes were practically orthogonal (perpendicular), that the orbits were practically tangent in the vicinity of the perigee of the killer's orbit and in the vicinity of the apex of the minor axis of the target's orbit, and that the interception took place after approximately two revolutions by the killer satellite.

Therefore, we may assume that the method used by the Soviets consisted of:

Selecting the apex of the minor axis of the target's orbit as the point of interception.

Injecting the killer in an orbit coplanar with the target's orbit; the injection was made at the point of interception selected, which was also the perigee of the killer satellite's orbit.

Selecting the velocity at the perigee of the killer's orbit so that after several revolutions, both the killer and the target would pass the point of interception at the same time.

When this method can be used, it does offer some advantages:

Injecting the killer at a point of the target's orbit means that even if there are errors in the coplanarity of the orbits, the orbits will still have at least one point in common.

The killer is injected at the perigee (or the apogee) of its orbit, thus ensuring that the orbits of the target and the killer will be practically tangent, since the target's orbit is practically circular.

The killer is placed in a coplanar orbit tangent to the target's orbit, thus reducing the variation caused by an erroneous determination of the pass times of the target and the killer at the point of interception selected.

The point of interception selected is the apex of the minor axis of the target's orbit, thus ensuring a maximum error tolerance in the position of the killer's point of injection in the target's orbital plane.

The method used for the other experiments differs from the method just described in the following ways:

The killer's first pass at the point of interception selected was not necessarily obtained upon injection, but after a change in orbit.

The major axes of the orbits of the target and the killer were not orthogonal.

The interception of Cosmos 400 by Cosmos 404 was made in the vicinity of the apogee of Cosmos 404.

The lack of orthogonality of the major axes of the orbits of the target and the killer may be explained by the fact that the **argument** of perigee of the killer's orbit differs slightly for killer satellites launched from the same site; this suggests that the orbital changes observed were obtained by a modification of velocity at the moment of a pass at the perigee or apogee, and by the fact that, for a practically circular orbit, the argument of perigee of the orbit of the target is highly sensitive to the slightest errors in the injection conditions.

Second Phase (February 1976 ---)

After an interruption of over 4 years, a new interception exercise took place in early 1976.

Cosmos 803, 804, and 814

Cosmos 803, launched from Plesetsk on 12 February 1976, was first placed, either directly or indirectly, in a low excentricity orbit at an altitude of 600 km (A: 624 km, P: 554 km, i: 66.0°, T: 96.4 mn).

Cosmos 804, launched from Tyuratam on 16 February 1976 at 0827.6 GMT, was first placed in an elliptical orbit with an extremely low perigee (A: 701 km, P: 148 km, i: 65.14°, T: 93.1 mn). At 0953 GMT, it was transferred to a low excentricity orbit at 600 km (A: 617 km, P: 560 km, i: 65.86°, T: 96.45 mn), whose parameters were corrected at 1306 GMT (A: 620 km, P: 528 km, i: 65.74°). At 1619 GMT, during its fifth orbit, Cosmos 804 made a pass near Cosmos 803, while the two satellites were south of Havana. After this nearby pass, Cosmos 804 was not destroyed, but was transferred to a new orbit with a low perigee (A: 928 km, P: 228 km, i: 67.60°). It was recovered on the ground the same day.

Cosmos 814, launched from Tyuratam on 13 April 1976, was placed in an elliptical orbit with an extremely low perigee (A: 701 km, P: 148 km, i: 65.14°, T: 93.1 mn). It made a pass near Cosmos 803, then was recovered on the ground the same day.

This new exercise (we may suppose, although we do lack orbital elements, that Cosmos 814 made maneuvers similar to those of Cosmos 804) differs from the preceding exercises in the following ways:

> The killer was placed in an orbit with parameters practically identical to the parameters of the target's orbit.
>
> The killer was recovered on the ground.

At the moment of greatest proximity, the two satellites had extremely close velocities. We can probably consider this exercise the first test of an inspection satellite. Recovery of the killer on the ground tends to support this interpretation.

In addition to the Cosmos satellites participating in the interception and/or inspection exercises which have just been reviewed, since the end of 1965 the Soviets have launched a certain number of satellites in the Cosmos series (see Table 2) which do have some analogies -- either in form, size, or orbital characteristics -- with the exercises just described. It may be assumed that these launches were designed either to test and to perfect satellites which were to participate in interception exercises, or to place targets or killers in space, which may have been used for interception exercises which were not successfully completed.

Cosmos Designation	Launch Date	Site
102	27 Dec 65	Tyuratam
125	20 Jul 66	Tyuratam
217	24 Apr 68	Tyuratam
291	6 Aug 69	Tyuratam
521	29 Sep 72	Plesetsk
752	24 Jul 75	Tyuratam
816	28 Apr 76	Plesetsk

Table 2: Other Cosmos satellites placed in orbit in the Soviets' interception and/or inspection satellites program.

The Soviets' Degree of Advancement in Interception and Inspection Satellites

As of this date, the Soviets have successfully performed nine satellite interception tests, but they have still not solved all the problems of interception, and they have certainly not eliminated all the difficulties presented by inspection. For one thing, the interceptions were performed under very special conditions. Secondly, the type of interceptions tested has great limitations in actual utilization.

At the moment of interception, the targets were apparently not maneuvering. Moreover, their movement was quite well known, since the targets were launched by the Soviets themselves, and the killers were launched after at least a 24-hour interval, which was enough time to learn the orbital characteristics of the targets with precision. Furthermore, the movement of the targets was carefully selected in order to facilitate a successful interception.

The targets were placed in practically circular orbits at relatively low altitudes (1000 km at most), but with variations between the perigee and apogee altitudes great enough so they were not just a matter of chance. The fact that the final orbits of the Cosmos 248 and Cosmos 373 targets were practically identical seems to confirm this assumption.

With these really cooperative targets, the Soviets performed their interceptions by injecting the killer satellites into coplanar orbits. Such interceptions can only be made with targets whose inclination over the equatorial plane is greater than the latitude of the points of injection of the killer satellites. Given the position of the Soviet territory, such interceptions are not practicable with targets having an inclination under approximately 35°. Moreover, from a given launch site, such interceptions can only be attempted twice a day. Unless launch sites for killer satellites are greatly increased in number and spread all over the Soviet territory, the targets can only be intercepted after a rather long delay. This is not compatible with any use against satellites which could pose the greatest danger to a nation, the FOBS systems.

The interceptions performed seem to have been made without terminal guidance. The precision was quite probably inadequate for a true inspection of the targets, their annihilation by any means other than detonation of an explosive device, or the interception of targets equipped with even very rudimentary evasion devices.

7679
CSO: 3100

KNUNYANTS' 50 YEARS OF SCIENTIFIC ACTIVITY COMMEMORATED

Yerevan KOMMUNIST in Russian 3 Aug 76 p 2

[Article by P. Kazaryan, doctor of technical sciences: "A Half-Century in Science"]

[Text] Major General Ivan Lyudvigovich Knunyants, academician, hero of socialist labor and Lenin Prize laureate, has commemorated his 70th birthday and 50 years of scientific activity.

The scientific community of our country and the scientific community abroad know I. L. Knunyants well: a distinguished, world-famous organic chemist; an eminent Soviet scientist who has made great contributions to the development of theoretical and applied organic chemistry. A versatile scientist, Academician I. L. Knunyants is, simultaneously, an acknowledged specialist in the area of the chemistry of fluorine and its organic compounds. He occupies a prominent place in the history of the development of this comparatively young trend in chemical science. He has proposed an entire series of new, original methods of synthesis of organic fluorine compounds which provide a basis for the technology of their industrial production.

Being a worthy student of the famous chemist (later academician) A. Ye. Chichibabin, thoroughly mastering the scientific school of classical organic chemistry, I. Knunyants was molded as a scientist of the new type in the ranks of the new Soviet intelligentsia which was born in the difficult and complex time of establishment of socialist economics. All of our people and scientists were forced to work with great intensity. From the beginning of his scientific activity, Ivan Lyudvigovich moved skillfully along the path of creation of new processes and new substances which have practical importance and which serve the interests of the national economy.

Even in the third course of the MVTU [Moscow Higher Technical School imeni N. E. Bauman] chemistry department, Ivan Knunyants revealed his outstanding chemical thought in his very first experimental work.

After completion of his studies at MVTU, he became a graduate student and then an assistant to his teacher. MVTU's classical scientific school of famed chemists in those years (A. Chichibabin, P. Shorugin, V. Rolionov, and others) developed in the young Knunyants scientific discipline, stoicism and purposefulness.

His first discovery was in the area of pharmacology. This was no accident. He understood that the young Soviet Republic needed help from chemists in the struggle against terrible diseases, including malaria.

In the terrible years of the 1920's, malaria raged in many regions of the country. Thousands suffered from it and lost the ability to work. Malaria is still a serious threat in some regions of Africa, Asia and Latin America.

In our country, malaria was considered to be a state problem. Thanks to measures conducted by the Soviet Government, malaria was practically eliminated even before World War II. I. Knunyants made great contributions to this struggle.

Successful control of malaria required the use of a medicine which our country did not have. The preparation for this disease, so-called atrabine, was first invented and developed in Germany but its chemical formula and technology of production were not published. Payment in gold was required in order to import this medicine. The young Soviet chemist I. Knunyants undertook the complex problem of creating a preparation which would help to control malaria. His persistent, creative search was crowned with great success. Deciphering the structure of atrabine, he developed an original method of synthesizing it, which method was introduced into industry and the preparation, named acriquine, was used extensively in therapy of different forms of malaria. The original, new technology of production of acriquine resulted in the use of intermediary products of its synthesis for the development of new medicines.

The word "introduction," as is well known, frightens any scientist and he prefers to be satisfied by grams of a new product he has produced, by publication of the results of his researches or by receipt of an author's certificate. This was not the situation with Ivan Lyudvigovich. Developing acriquine and giving it to medicine, he, of course, could consider his duty as a scientist fulfilled. Only his close colleagues know how much effort and energy he gave to the development of the technology and the industrial introduction of this valuable medicine. In 1937, Ivan started up the Staroya Kupavna acriquine plant, giving the country the much needed, at that time, medicine for treatment of malaria. Now the acriquine plant is one of the most powerful enterprises of the medical industry and it produces a wide assortment of medicines.

For development of another medicine, acetobutirolactone, or "Knunyants' Lactone" as it is called in the Soviet Union and abroad, which is still an important initial reagent for production of many medicinal compounds, including Vitamin B_1, Ivan Knunyants was awarded the State Prize in 1943.

I. L. Knunyants always tried to subordinate scientific activity to the solution not only of fundamental problems but of practical problems of development of the chemical industry.

The time came when the country faced the problem of developing polymer chemistry and the establishing of synthetic polymer materials for different areas of science, technology and industry. It became obvious that the successes of developing chemicals for the national economy were associated, primarily, with the tempos and scales of development of production of polymer materials without which it is impossible to introduce modern machine construction, electrical engineering, radio engineering and many other sectors. The role of synthetic polymer materials (plastics, fibers, vulcanized rubber, crude rubber and articles based on them) is increasing rapidly in production of materials. These materials facilitate the growth of technical progress of our country. Moreover, new phenomena are always being sought in chemistry. Ivan took care of one complex problem, the creation of new types of synthetic fibers for the textile industry.

In 1942-1943, I. Knunyants, in collaboration with Z. Rogovin and Yu. Romashevskaya, discovered the phenomenon of polymerization of caprolactam, a polymer from which is obtained caprone fiber. He was awarded the State Prize in 1950 for his development of a method of synthesis of the new synthetic fiber. Now, there is produced in the USSR and abroad tens of thousands of tons of caprone and articles manufactured from it are in great demand.

I. Knunyants was interested in problems of polymer chemistry during World War II when there arose an urgent need for synthetic polymer materials both for defense technology and for the needs of different sectors of the national economy. Caprone was developed in the USSR in 1943.

Ivan Lyudvigovich continued work in the area of improvement of methods of production of previously known synthetic fibers--nylon, for example. He decided to produce a fiber analogous to nylon by use of a simpler scheme, on a new, comparatively cheap raw material base. He used a new reaction, electrochemical dimerization, in this process. We must add that, at present, this progressive method for nylon production is used extensively in industry.

Scientific research in the area of the chemistry of fluorine and its compounds, conducted by a collective of chemists directed by Academician Knunyants, enriched science, technology, medicine and other spheres of human activity with new theoretical and practical results.

One of the most valuable traits of talent of Ivan Lyudvigovich is the rare gift to sense, understand and establish the proper trend, the urgency and importance of a chosen object of investigation.

More than 40 years after his discovery of fluorine, the element was considered to be inaccessible, unsubdued in view of the extreme difficulty of conducting experiments with it. Not many know how many "dramatic situations" were experienced by those who "dared" to tame fluorine and to produce it in the free state. Nothing can withstand its aggressive "temper." Fluorine corrodes glass, wood and fabric, breaks out of rubber instantaneously and burns in air. It is highly toxic. It is no exaggeration to say that the discovery of the secret of this mysterious element and the development, on its base, of an entire class of valuable organic fluorine compounds is a laborious and creative feat of organic chemists. Here the services of Ivan Lyudvigovich and his students were great. The extensive research, conducted even now in his laboratory of the chemistry of fluorine and of fluorine organic compounds and especially fluorine polymers opened a new chapter in the theory of organic chemistry and placed at the service of science, technology and the national economy, new valuable materials. Research by Academician Knunyants, head of laboratories of the Institute of Elementary Organic Compounds AS USSR, in the area of fluorine organic compounds, won him the Lenin Prize in 1972.

In addition to his scientific activity, I. Knunyants conducts important educational activity. He was, for more than 40 years, professor of the Chair of Organic Chemistry of the Military Academy of Chemical Defense imeni Marshall of the Soviet Union S. K. Timoshenko. He has supervised the preparation of more than 150 candidates of sciences and more than 20 doctors of chemical sciences.

He gives great attention to the training of scientific personnel for the Union Republic, including Armenia. Many candidates of chemical sciences, trained in his laboratory, now work in the republic.

He reached the apex of science quickly and at the age of 30 he was a candidate of science, a doctor of chemical sciences at 33, a professor at 34, a corresponding member AS USSR at 40 and an active member at 47. He meets his 70th birthday full of health and vigor. He is still indefatigable at work and is full of new, scientific thoughts.

2791
CSO: 1870

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

WORLD'S FUTURE CLIMATE DISCUSSED

Moscow IZVESTIYA in Russian 21 Aug 76 p 5

[Article by A. Velichko, doctor of geographic sciences, Head of Paleogeography Section at USSR Academy of Sciences Institute of Geography: "What Will Our Future Climate Be?"]

[Text] Beginning in the second half of the 20th century the energy burden placed on the natural environment of the earth, connected with the vigorous growth in population and its industrial-agrarian activity, has grown enormously. That load will continue to grow in the future.

In that connection of particular importance is the forecasting of and the unique "neutralization" of human unfavorable influence on the environment, and particularly on the climate. It has been said, for example, that the carbon dioxide content in the atmosphere in just 100 years will reach such a level as a result of industrial waste that in broad areas of the earth the temperature will rise by 10 degrees and marine and continental ice will begin to melt. The consequences of that phenomenon can be quite impressive since the structure of today's climate in the earth to a significant degree is determined by the ice condition in the polar areas. The planet's water balance would also drastically change in such a situation. Naturally, that was only a suggestion. It is hard to imagine that humanity, armed with contemporary knowledge and technology would allow that to happen. But weather specialists must study just that potential possibility and must be ready to answer the question: what will our future climate be on this planet?

Under consideration are other factors of human influence on the climate which might bring about consequences of a completely different nature, for example, atmospheric dust pollution. Several scientists believe that, as a result of economic activity, the content of aerosol particles in the atmosphere by the year 2000 might reach

60 percent in comparison to the present time. In that case the amount of solar radiation reaching the earth would decrease considerably and there would be a cooling effect.

As you can see the two suggestions are diametrically opposed.

But I am not going to subject those to a thorough analysis and I cited them only so that it would be clear to the reader how important it is, in resolving questions dealing with environmental protection and the rational utilization of natural resources, to investigate the possibility of an emergence of unpremeditated, global natural-climatic oscillations that are brought about by man. For example, in going ahead in implementing grandiose projects to bring water to dried out regions, it would be of quite significant importance to know what kind of climatic conditions would evolve in the relatively near future when planning large installations to be built on permafrost, it would be necessary to know whether in the foreseeable future there would be a warming trend which would require a strong restructuring of the condition of the ground and the relief in that area. That is why it becomes a vital task to model those conditions of the environment which would correspond to possible changes in the environment. Investigations in that direction are complicated by the fact that the influence of human activity evolves in a complex background of changes in nature in the course of its own, natural development. For surely the contemporary state of nature in our planet is merely a link in the chain of its total evolution.

The history of the formation of today's natural environment and the natural-climatic changes in the past are subjects of research for science that are called paleogeography. Modern paleogeography is based on methods which make it possible to reconstruct the natural circumstances of the past (including vegetation, soil cover, fauna, and the condition of water basins), and make it possible to study the signs of the distribution of ancient glacial plates and long-term permafrost.

The present geographic cover belongs to one of the two principal conditions that has been characteristic of the earth for at least the last two million years, and that is the warm, interglacial type. In general almost every school child knows what the "face of the earth" looks like today. But what was it like during the glacial period? That was a time in which there was a sharp drop in temperature (particularly during the winter), an intense reduction in precipitation, and a different system of air circulation. The system of broad natural zones that are familiar to all of us from our geography textbooks weakened and dissipated as it were.

In the last 700,000 years alone there were no fewer than five such glacial eras. The most severe such era was the last one which began some 70 to 80,000 years ago. The maximum cooling occurred approximately 20,000 years ago. One of the most surprising features of nature during that time was the disappearance of forest belts in the entire non-tropical area of the globe. That fact has now been established not only for the Northern Hemisphere but also for the Southern Hemisphere. The tundra-steppe zone began from the edge of the glacial cover and moved to the steppes. And in turn they were replaced by semi-deserts and deserts. The ocean level dropped by more than 100 meters in comparison to the present-day level and broad areas of present-day shallow water regions were joined to the land and changed the outline of the continents.

The climate in even such regions which we consider to be favorable as the center of the Russian plains and the north of the Ukraine, was even more severe than the climate of Central Yakutiya. The temperature in the winter there dropped to 40-30 degrees below zero and the amount of precipitation was not more than in today's semi-deserts. The region of long-term permafrost occupied not only Siberia but encompassed almost all of Europe up to the territory of Spain. The southern border of the broad cap of marine ice areas connected with the permafrost border from the oceanside. If one could take a look at our planet from space at that time its appearance would be quite different from that observed at the present time by astronauts.

Approximately 10,000 years ago the natural mantle changed to a different state and began to develop into a warm, interglacial type. However, there are features manifested in its present structure which are inseparably bound to the past.

There are many components in nature which directly correspond to the present character of solar radiation which reaches the surface of the earth (for example, vegetation). But there are also elements in the present structure of the natural cover of the earth which have reached their maximum degree of development in the cold era and are now in a suppressed state (for example, perennial permafrost). Nature has, as it were, inherited those elements from the past.

One can say that our present-day climate also possesses features of heredity. It particularly depends to a large degree on the distribution of ice in the polar regions. And those regions, in their turn, constitute a remainder of a broad cap which decended 20,000 years ago to the latitudes of the present-day subtropics. The landscapes of Eastern Siberia constitute relics of this past cold era.

An examination of the possible course in future natural changes in nature and the modeling of natural conditions of the future indicates that there will probably be a displacement of the present warm era by a cold, glacial era.

A paleogeographic analysis of the contemporary era of natural development indicates that our interglacial era is colder than the preceding one. A study of the evolution of soils and vegetation indicates that its warm "peak" has already passed and that the last two to three thousand years have been characterized by a general inclination towards cooling. It has been suggested that the transition to the next cold era might take place within the period of three to five thousand years.

But, besides the more general shifts in heat and cold (we call them macro and meso-scale climatic changes), there are still the so-called macro-scale natural climatic changes. Among those, for example, are phenomena such as the small glacial era of the 13th-17th centuries or the warming climate in the middle of our own century. It is possible that such changes reflect the approach of transitional phases in states from the eras of one type to another.

It is particularly important for us that natural fluctuations in climate of all three categories can be strongly changed (either diminished or intensified) by influences on the climate which is brought about by human activity. Weather specialists are confronted by a complex task: to determine the total effect of various anthropogenic factors which are responsible both for warming and for cooling. This would make it possible, by forecasting natural conditions of the future, to base our studies on the reconstruction of conditions which existed in the past. Such reconstructions--models in the form of a series of paleogeographic maps, are being developed at the USSR Academy of Sciences Institute of Geography.

For example, if climatology establishes a tendency towards a significant warming, the reconstruction of the last interglacial epoch (120-80 thousand years ago) could serve as a probable model for changes in the natural situation. The conditions of that epoch were more warm than the contemporary ones, and ice in the Northern Hemisphere was considerably reduced or even completely disappeared. The level of the sea raised to 10 to 12 meters higher than the contemporary one. Atlantic masses of air, rich in precipitation, penetrated the territory of Eurasia profoundly. The Siberian anticyclone was weakened as a result of which the winter temperatures were vigorously increased not only in Eastern Europe, but probably in Western Europe as well. Vegetative and soil associations that are now characteristic of Central and Western Europe were propagated in Eastern Europe. The borders of the forest region extended 300 to 400 kilometers further south than the present ones.

On the other hand, in the light of a dominating influence which the factor of atmospheric pollution and a clear tendency towards a cooling, it is possible there will be an acceleration of the transition to colder phases of the interglacial cycle or a beginning of a glacial cycle, and in that case one should examine the reconstruction of conditions that are characteristic of the glacial epoch.

In this way, forecasting changes in the natural environment is connected with a profound elaboration of fundamental problems in its general revolution and with the search for the characteristics of the causes of natural changes including those which are brought about by human activity. Such a complex approach will in the future make purposeful control of climate a realistic one. Having studied precisely how to evaluate the relationship between climate and the aforementioned factors, one can rationally influence natural changes on the climate.

The study of the state and changes in the natural environment require joint efforts on the part of specialists of various countries. In particular a congress is being dedicated to that which will take place among Soviet and American scientists and which will be conducted at the end of the present year within the framework of an inter-state agreement between the USSR and the U.S.A. on environmental conservation.

The time has come to join the efforts of climatologists, paleogeographers, glaciologists and other specialists to create in our country a unified research project for the study of the dynamics of the natural-climatic changes, their forecasting and regulation. This will make it possible to assure the greatest effective resolution of important problems in the protection and rational utilization of natural resources.

6289
CSO: 1870

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SCIENCE AND PRODUCTION: RESERVES AT JUNCTIONS

Moscow PRAVDA in Russian 3 Aug 76 p 2

[Article by B. Paton, academician, president of Ukrainian SSR Academy of Sciences]

[Text] The acceleration of scientific and technical progress is a nodular problem of the development of the economical structure of the country, the guarantee of further increase of the effectiveness of public production and the successful fulfillment of tasks set by the 25th CPSU Congress. Soviet science plays a responsible role in this key trend of common efforts. As secretary general of the CPSU Central Committee Comrade L. I. Brezhnev noted in his summary report of the CPSU Central Committee at the 25th party congress, only on the basis of accelerated development of science and technology can the final problems of the social revolution and the construction of a communist society be solved.

The steady growth of scientific and technical potential is being guaranteed by an extensive system of measures, purposefully realized in conformity with the long-term strategy of the party. An important component of this system is the constant improvement of organization of scientific work, the increase of its effectiveness, the practical checking of all new progressive forms that connect science and production. Institutes and scientists of the AS UkSSR have, over a period of some years, conducted research along this line. What are the results of this? What are the conclusions reached?

There is nothing more practical than the good theory and basic support the AS UkSSR gives to the development of fundamental research in the areas of mathematical, physical, chemical, geodesic and biological sciences. Significant successes have been achieved in many sectors of contemporary natural science. The physicists, students of materials, physiologists, cyberneticists, mechanics and chemists trained in our scientific schools have contributed greatly to domestic science and have received recognition abroad. The fruits of basic research serve as a base for applied research, one of the basic conditions for solution of major inter-sector scientific and technical problems. In the Tenth Five-Year Plan the AS UkSSR is participating in fulfillment of 82 all-union coordination programs.

During the organization of research, primary attention is given to the most promising scientific trends. Efforts and funds are concentrated where institutes are already occupied or may assume, in the very near future, a leading place in the country or in the world. This permits effective use of existing potentials and funds. Preference is given to complex programs and, recently, special purpose programs which provide for solution of fundamental problems and, at the same time, the achievement of specific, applied results.

The Presidium, the party organizations and the collectives of progressive scientific institutions of the academy constantly keep in mind the practical use of results of research. On the basis of scientific achievements of the AS UkSSR in collaboration with scientists of the AS USSR, of other departments and ministries' new sectors such as special electrometallurgy and powder metallurgy were born and highly effective methods of welding, hydroextrusion and casting came into practice. Many technological processes, equipment, systems of means of automation were developed and are being used extensively. Some of these have a scientific and technical level which are unequalled in the world. During the years of the Ninth Five-Year Plan alone, institutions of the AS UkSSR have introduced into the national economy of the country more than 2,700 operations with an economic effect of nearly 900 million rubles.

The majority of the developments of institutes of our academy, thanks to their newness in principle, are highly effective and are quickly repaid and therefore are in great demand, especially in ferrous metallurgy, the chemical industry, machine construction, radio electronics and medicine. They have been used in the most important constructions of the Ninth Five-Year Plan such as, for example, the Volga Motor Vehicle Plant, the Kamskoye Motor Vehicle Plant, blast furnace No 9 of the Krivorozhkiy Metallurgy Plant and the Baykal-Amur Trunk Line.

In each of these cases, the interaction with production was structured differently but certain common characteristics could be isolated. What are these characteristics?

I want to place first the complex approach to the solution of problems involving the increase of the effectiveness of science.

The most important condition of a successful introduction of scientific developments is the high level of readiness of them for practical application. It depends greatly upon the state of the experimental and production base. Its planned development is facilitated by the creation of modern methods of scientific experimentation which insures the required level of both fundamental and applied research and assists in the increase of the

volumes and rates of introduction of results obtained. While, in 1965, scientific research in the AS UkSSR was provided by 16 cost accounting subdivisions of institutes with an overall production volume of nearly 12 million rubles per year, by 1975 there were 54 sub divisions with overall production of nearly 100 million rubles. In the past year, they completed development and transferred to the national economy more than 400 kinds of devices, apparatus and technology.

In recent years there arose a qualitatively new form of connection of basic research with construction and design operations and production. There were created, on the base of leading institutes of the academy, major scientific complexes, consisting of an institute, a design bureau, experimental production and an experimental plant. These complexes insure the completion, in a short time, of scientific research up to introduction of the innovation into the national economy. The high efficiency of the well known, in the country, institutes of electro-welding imeni Ye.O.Paton of cybernetics, problems of materials study, physicotechnical low temperatures and superhard materials of the AS UkSSR insure the organization of such complexes. At present they are being formed in many other institutes. The persistent development of the experimental-production base has justified itself.

Moreover, experience revealed several unused possibilities. While it was impossible to overcome the economic dissociation of sub divisions of complexes, centralization of administration was inadequate, breakdowns in the materials and technical insurance were frequent. Therefore, the Presidium AS UkSSR proposed development of an improved form of organization of research, an academic scientific and technical union. It is conceived as a scientific research, technological-design and economic-production complex headed by the institute. All stages of the "research-experimental production-introduction" process are under control of this union according to a continuous plan.

The creation and mastery of scientific and technical innovations requires, in some cases, the efforts on scales of a sector or even several sectors and not one but a group of scientific collectives. In such cases, assistance comes from the purposeful complex planning of applied researches and studies for the introduction and cooperation of efforts of scientific and production collectives.

In the Ninth Five-Year Plan, there was work on the organization of joint operation of the AS UkSSR and individual ministries on complex plans of scientific research and introduction of it. They provide for the solution of several important national economic problems within the limits of a sector. The compilation of such plans permitted formulation of a long-term collaboration program and provided not only opportune accomplishment

of scientific developments but also the preparation for production of conditions for introduction (appropriate capacities, materials and technical provision, personnel).

An example is the joint decree of the AS UkSSR Presidium and the board of the Ukrainian SSR Ministry of Ferrous Metallurgy in conformity with which more than 50 scientific research studies have been completed, more than 20 developments and 10 new articles and materials have been introduced. Among these, for example, are the basic propositions of the cyclic-flow technology of mining operations. Experimental-industrial checking indicated that its use, in the Krivoe Basin mines alone, provided savings of nearly 20 million rubles per year.

The coordination plan of the AS UkSSR and the USSR Ministry of Chemical Industry for 1976-1980 provides for fulfillment of 56 major, joint developments and ensures reinforcement of 12 scientific institutes of the AS UkSSR, 35 scientific research and design organizations of the Ministry of the Chemical Industry, 36 unions and enterprises.

In recent months, upon the initiative of the AS UkSSR and of the Moscow Atvo-ZIL association arose still another form of organization of applied research and introduction -- the conducting of operations in the interests of unions and major enterprises according to complex scientific and technical problems, the end goal of which is the development of new technologies which insure the creation of waste-free production in machine construction. There are also planned programs of collaboration with the Krivorozhkiy Ore-enrichment Combine, the "Artemugol' " Union and others. In all, in the AS UkSSR, 15 such programs have been formulated up to the present. There will be 50 institutes participating in their fulfillment.

The great possibilities of academic institutes affect the development of major industrial regions of the republic. In the last 10 years, in some regions of the Ukraine on the basis of appropriately profiled sections and departments of institutes, there are created new scientific institutions and the subjects of existing institutions are defined more clearly. This insures the intense development of basic and applied research in the interests of and on the basis of the most important sectors of the economy of a given region. Thus, the creation at the Donets Scientific Center AS UkSSR of institutes of the economics of industry, physico-organic chemistry and coal chemistry, the profiling of the Donets Physico-Technical Institute in the direction of physics and high pressures technology, hydro-extrusion, physical study of materials are dictated by the interests of the coal, metallurgical and machine construction industries of this region.

Organization of sectoral laboratories is being practiced ever more extensively. At present, there are 26 sectoral laboratories of 15 union

ministries in institutions of the AS UkSSR. Laboratories are functioning successfully in institutes of physics, semiconductors and cybernetics, including the Donets Physico-Technical, radio physics and electronics in Khar'kov, the Physico-Technical Institute in L'vov and others.

Contracts concerning socialist collaboration have been distributed widely. In 1975, more than 500 such contracts were concluded between academic institutes and enterprises.

Are all reserves of increase of effectiveness of research exhausted? No, not all. Results achieved may be more fruitful under conditions of the solution of several problems which impede development of scientific research and the introduction of their results into the national economy.

The materials and technical supply of scientific institutions are inadequately aligned. This has a negative effect on the level and the tempos of research and introduction. Increase of the effectiveness of operation would facilitate also the formation of funds of social and cultural measures and residential construction, economic incentive at academic institutions at the expense of their profits.

Not all institutes of the AS UkSSR were able to concentrate their efforts on major problems which have significant scientific and national-economic importance. The problem of creation of new technological processes at the higher level which embrace the production process is not, on the whole, getting the extensive solutions needed. Some institutes are too slow in relinquishing subjects of lesser importance and their structure has not been reorganized to insure maximum flexibility.

Experience proves how great are the possibilities which are revealed by the regulation of the relations between fundamental and applied science, between science and production. Precisely on these junctions, we intend to seek, in the future, reserves of increase of effectiveness of research and the acceleration of scientific and technical progress.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

CARTOGRAPHY'S ROLE IN SCIENTIFIC-TECHNICAL REVOLUTION TOLD

Moscow PRAVDA in Russian 3 Aug 76 p 6

[Article by I. Kutuzov, chief of the Main Administration of Geodesy and Cartography for the USSR Council of Ministers; marking opening of the Eighth International Cartographic Conference in Moscow, 3 August 1976: "Cartography Serves Progress"]

[Text] Man's knowledge concerning the earth has been extended since ancient times by the creation of geographical maps. As a result of geographical discoveries "blank spots" were filled in and cartography faced new and ever more complex problems. Now a man has become a necessary document for the solution of a wide range of scientific and economic problems and cartography as a whole has become a faithful assistant of technical progress. It can be said that it, together with other sciences, promotes the greatest achievements of the scientific and technical revolution.

The earth sciences and thematic cartography are especially closely interassociated. Not one of the problems emerging in this area, including the provision of fresh water to mankind, the study of the resources of the world ocean, the complex study of the continental shelf and development of the agricultural productivity of agricultural lands can be solved without appropriate provision of cartographic information.

In our country the most diverse thematic maps, including soil maps, geobotanical, geological maps, maps of forests and peat resources and others, are being developed. Decrees of the 25th CPSU Congress require further expansion of the operations for provisions of adequate maps to planning agencies and administrations of the national economy. Proceeding from these needs, the system of provision of thematic maps and atlases of different content and scales are determined.

Development of procedures for compilation of resource maps and maps used for appraisal and prognostication--for example, maps of the Baykal-Amur Trunk Line and the Non-Chernozem Zone of the RSFSR--are of greatest significance. Part of these already have been issued and have become part of the equipment of a number of sectors of the national economy.

It is also very important to improve the principles of creation of complex maps and a number of other thematic maps (forestry maps, geomorphological maps, soil maps, economical maps, etc.), the demands for which are increasing constantly.

It is well known that the effectiveness of a series of maps, created in the process of complex mapping, is much higher than uncoordinated productions of analogous thematics. The solution of this problem is assisted by the wide use of photographs from space, each of which contains information, capable of satisfying the needs of specialists of many contiguous sectors.

As we see, cartography, in order to more completely satisfy the needs of the national economy in its production, uses the most modern technical means. This refers not only to space technology. There is presently a need to increase cartographic output significantly and to reduce the term of its creation. This requires extensive use of mathematical methods, of electronic computer technology of different automatic devices.

Contemporary cartographic production involves information included in many tens of thousands of plates of representations of a locality, with millions of geographical names. Their effective use is unthinkable without the needed organization of the appropriate scientific organization. Automated systems for its collection, storage, search and distribution are being developed and centralized reference-information funds are being developed.

There are underway, in the Soviet Union and abroad, successful operations in the creation of converters of cartographic images into digital form for subsequent input into an EVM /Digital electronic computer/ and automatic tracing of the map.

One of the most complex problems of automation is the creation of mathematical methods, algorithms and programs for modelling on an EVM of the composition of maps. Some processes such as this do not have sufficiently strict mathematical criteria and formalized rules. However, most recent research gives reassuring results.

Still another trend of automation is associated with the development of slave devices for reproduction on the basis of digital information obtained from an EVM of a cartographic image in the form of published originals of maps. Achievements in this direction exist in some countries. This was indicated at the commercial exhibit of equipment at "Cartography and Geography 1976" as a part of our conference.

In recent times, cartography has stepped from earth into space. In the USSR, maps and globes of the moon have been published. Now it is practically possible to create maps of both individual parts of the moon and other planets of any scale and for the planet as a whole. The need

for this is understood since investigation of other heavenly bodies is impossible without detailed maps, representing landing spots for automatic stations.

Even this meager presentation indicates the complex problems facing cartographers of the world and we hope that the present conference will facilitate the successful solution of them.

The many papers presented at the conference by representatives of 40 countries and the accompanying exhibit of maps and atlases show convincingly that contemporary cartography has a beneficial effect on scientific and technical and social and economic progress.

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SOVIET AND HUNGARIAN PETROCHEMISTRY EFFORTS

Baku BAKINSKIY RABOCHIY in Russian 1 Aug 76 p 2

[Article by I. Orudzheva: "For Hungarian Petrochemists"]

[Text] The Hungarian People's Republic, with the aid of the Soviet Union, has been building its own petroleum-refining and petrochemical industry. The VNR (Hungarian People's Republic) also produces additives--specially synthesized compounds whose addition to lubricants improves their quality. Hungarian scientists and engineers are greatly interested in the experience of the Azerbaydzhan SSR Academy of Sciences Institute for the Chemistry of Additives whose work is being conducted in an all-embracing manner. That work includes the synthesis and study of additives, the development of their manufacturing process and industrial use. Our Hungarian colleagues have been coming to Baku to become familiar with our institute's operations.

Now our fraternal socialist country has been visited by academician A. M. Kuliyev of the Azerbaydzhan Academy of Sciences and director of the Institute for the Chemistry of Additives. He was invited to meet scientists of the Hungarian Academy of Sciences in Budapest and associates of the Institute of Petroleum and Natural Gas in Vesprema. A. M. Kuliyev presented papers in both cities on new directions in the production and use of additives to lubricants and fuels. Hungarian petrochemical specialists advocated broader scientific ties with Azerbaydzhan and the organization of joint efforts in additive research.

A. M. Kuliyev brought back with him from the VNR his book "Khimiya i Tekhnologiya Prisadok k Maslam i Toplivan" (The Chemistry and Technology of Oil and Fuel Additives) which was published in Hungarian in Budapest in 1976. (Incidentally, it is now being translated into Czech). In the preface of that book the wellknown specialist in chemical engineering M. Froynd, characterizes the content and significance of the monograph and expresses the confidence that it will be of invaluable assistance to scientific workers and teachers at research and teaching institutes of Hungary.

A. M. Kuliyev's book was published in Russian in 1972 by the "Khimiya" press in Moscow. There is no similar monograph either in the Soviet or foreign literature. It therefore has become popular not only among petroleum refining specialists, petrochemists and students, but also among specialists of various sectors of the national economy which use petroleum products. In recent years the author and the staff he heads have accumulated a vast amount of new material, both applied and experimental, which is of interest to both industrial and scientific workers. We believe it would be advisable if a second supplementary edition of the monograph were published, particularly in view of the fact that the Tenth Five Year Plan has placed before industry vital tasks with respect to improving the operating qualities of fuels and oils.

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FIRST SCIENTIFIC CRUISE OF THE AYU-DAG

Tallin SOVETSKAYA ESTONIYA in Russian 14 Aug 76 p 3

[Article by A. Favorskaya]

[Text] She is a beauty, a white ship with 1,000 tonnage, that is to make its first research cruise in the Baltic Sea.

Before she "moved" to Tallin, where she is under the jurisdiction of the Institute of Thermophysics and Electrophysics, Estonian Academy of Sciences, the Ayu-Dag was a passenger vessel of the Black Sea Steamship Line. But her masters of yesterday would have little to recognize now: many of the cabin partitions have been removed, and along the walls, all sorts of instruments are closely stacked on long tables. Here, scientific research laboratories are being installed for long-term work. Physicists, chemists and biologists are to make a thorough study of the Baltic Sea, from the standpoint of controlling pollution. Yet our sea, as maintained by the specialists, is very complex in its chemical and physical properties. And it is very difficult to predict effective measures to implement control from the shore or on the basis of coastal studies. Direct measurements are needed, in the open part of the sea. And this is what the Ayu-Dag will now be doing.

Professor Ayn Aytsam, head of the Baltic Sea department of the institute and leader of the expedition, tells us: "The purpose of the first cruise is to obtain some preliminary information on how toxic substances spread in a marine environment."

Research on different aspects of behavior of the sea is a complex task. Our cruise will concurrently involve participation in the international BOSE experiment that is being conducted by a working team consisting of representatives of all Baltic countries dealing with investigation of the Baltic Sea. At the present time, our ship, as well a s Swedish GDR and Polish vessels are involved in this experiment. Incidentally, we shall have a good opportunity to discuss objectives for next year. During the cruise, we shall visit our colleagues in Kiel, Copenhagen and Stockholm.

And, of course, our investigations are closely coordinated in a unified program with the work being done on marine research at the academic institutions

of Latvia and Lithuania. The expedition members also include a team from the Institute of Oceanology imeni P. O. Shirshov, USSR Academy of Sciences, with which we have already been collaborating for about 10 years."

Complex research and approaching the general problem from different aspects--how is this reflected on board the ship? We are told that all these complicated and clever instruments with automatic recording devices can take measurements night and day, in any weather, and their data supplement one another. The probes dropped to up to 60 meters will provide, so to speak, instantaneous vertical "sections" of water layers: their temperature, salinity, oxygen content, etc. (Several of the instruments were specially designed and developed for such cruises right at the Institute of Thermophysics, and their chief designer, Rayvo Portsmukh, is also sailing on this expedition). In the laboratory next door, we meet another instrument designer, Uno Veysmann, from another institute, the Institute of Astrophysics and Atmospheric Physics in Tyraver. Heretofore, his equipment had "flown," and now it would be involved in marine research, for example, investigation of brightness of the sky above the open sea, which will also add to the overall findings.

Oceanologists from Moscow, Iosif Lizovatskiy and three others (they share a laboratory with Veysmann) have installed an entire set of recording and measuring equipment, which was developed at their institute, on board the ship. There is not another like it in the Soviet Union: a wide assortment of pickups and a wide range of frequencies. This permits investigation of the hydrophysical distinctions of our sea, observation of which is very important to comprehend transmission of energy from the atmosphere to the ocean, and it could ultimately confirm or refute existing theories.

All this will aid in forming an idea about the Baltic Sea as a system.

The Ayu-Dag is a new ship in the family of research vessels of the USSR Academy of Sciences, whereas it is the first in our republic's academy that will make possible expeditions on such a scale. And the scientists have asked us to convey that they are very grateful to the republic's government which aided in procuring such a ship. They are also pleased with the excellent crew and captain that the Estonian Maritime Steamship Line assigned to the Ayu-Dag.

... Just before the ship sailed, preparations were made for the cruise which will last 1 month. The members of the expedition abstained from extensive interviews, and the reporters understood why.

Let us consider that the most interesting interviews will come later.

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NEW LUNAR SOIL SAMPLE

Baku BAKINSKIY RABOCHIY in Russian 27 Aug 76 p 2

[Article by A. Romanov (TASS)]

[Text] Report From the Institute of Geochemistry and Analytical Chemistry Imeni V. I. Vernadskiy

... We are in one of the institute laboratories. People in white coats have gathered in a small room, in which there is a vacuum chamber--a large cylinder with illuminators [portholes?]. And it is expressly into this chamber that a capsule with lunar rock was brought from the landing site; this sample was taken and delivered to earth by the Luna-24 unmanned interplanetary station.

This capsule is cylindrical in shape, 0.5 meter in height and 10 cm in diameter. It contains samples of lunar soil "packed" by the automatic geologist into a narrow "sack" almost 2 meters in length, the so-called soil sampler. Its size corresponds to the depth of the "shaft" drilled on the moon.

On 25 August, manipulations were performed in the vacuum chamber in order to extract the "lunnite" from the soil sampler. First, operators V. Vysochkin and A. Sherstyuk carefully manipulated the soil sampler [or coring tool?] into a special shape resembling a spiral. By means of roentgenoscopy determination was made of soil level in the soil sampler and, at the same time, the structure of the rock was demonstrated. At last, the final operation: separating the soil sampler in approximately 30 cm sections and extraction of the soil proper onto a specially prepared tray.

A few minutes after this work was completed, the reporters were able to take a look at the samples of lunar soil through the illuminators.

... There is a grayish-silver strip of "lunnite," with a brownish cast, on a small tray. A. Ivanov, senior scientists, explains to us:

"The core sample of lunar soil, which was obtained in the Sea of Crises, differs little in appearance from samples obtained previously. This is a typical lunar regolith. However, it is lighter than the sample delivered

by Luna-16 and darker than the one brought by Luna-20. Take a look at this "section" of soil," the operator advises, "here we see granules, of which there are more in this sample than in previous ones. They are up to 5-7 mm in size."

Yu. A. Zolotov, corresponding member of the USSR Academy of Sciences, and Professor K. P. Florenskiy give us some details about the first studies and future plans with regard to studying the "lunnite."

"First of all," Yu. A. Zolotov stated, "we are highly appreciative of the work done by scientists, designers and engineeers, who brilliantly conducted the experiment involving delivery of lunar soil to earth. We are afforded a new opportunity to investigate the chemical and mineralogical composition of the sample taken by Soviet automatic equipment from the third region of the moon."

K. P. Florenskiy adds: "It is important to compare all three samples of lunar rock [soil]. For Luna-16 and Luna-24 have delivered soil to us from regions of sea plains, while Luna-20 brought one from the mountain region lying between them. I believe that such a comparison will enable us to draw some interesting conclusions on the geological structure of a vast part of the moon. We noticed that the new soil sample, unlike previous ones, is more laminated. One would think that this fact will help us lift the curtain over geological processes that took place on the moon ["selene"] in different periods of its existence. And this is of enormous scientific significance. Probably, we shall again encounter many of the elements of the Mendeleyev periodic table, which are seen on earth, in the lunar soil samples."

In conclusion, Yu. A. Zolotov reported that the institute scientists are working out a plan for comprehensive and in-depth examination of the lunar soil samples, in which Soviet and foreign scientists will participate.

[Photo caption] Receiving laboratory of the USSR Academy of Sciences, Moscow, before inspection, near the vacuum chamber with lunar soil delivered by the Soviet unmanned Luna-24 space station. Photography by V. Kuz'min (TASS).

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

CONGRESS OF CHEMISTS

Moscow EKONOMICHESKAYA GAZETA in Russian No 39, Sep 76 p 17

[Article by V. Savel'yev]

[Text] The Seventh International Congress on Surfactants (PAV) ended in Moscow a few days. ago. It was attended by specialists from 29 countries. About 250 papers were delivered and discussed.

Surface-active substances are a special class of chemicals with one feature in common, superficial activity. It would be difficult to exaggerate their importance to various branches of the national economy. For example, in household chemistry (where, actually the use of PAV began), they serve as the basis for synthetic detergents, they are used in the manufacture of polishes, pastes, glue and creams.

Today, at the time of scientific and technological progress, the paint and varnish, textile and petroleum industries, metal processing, mine-concentration enterprises and polymer production could not manage without PAV. In agriculture, PAV are needed to produce granulated fertilizers, foam to protect plants and soil from freezing, and for treatment of some types of solid feed.

At this congress, much attention was devoted to questions of effects of PAV on the environment and living organisms, and prevention of environmental pollution. Soviet specialists reported to the congress participants about the extensive work being done in this direction in our country.

This international forum of chemists made a new contribution to the cause of further strengthening of collaboration in an important branch of modern science and technology.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

AZERBAYDZHAN ACADEMY OF SCIENCES ANNOUNCES IT IS NOW ENROLLING GRADUATE STUDENTS (FALL, 1976) IN THE SPECIALTIES LISTED

Baku BAKINSKIY RABOCHIY in Russian 4 Aug 76 p 4

[Article by the Presidium of the Azerbaydzhan Academy of Sciences]

[Text] Full-time enrolment [requiring leave from job]:

"Order of Red Banner of Labor" Institute of Petrochemical Processes imeni Yu. G. Mamedaliyev: Chemistry of high molecular compounds, automatic control and regulation.

Sumgait Branch of "Order of Red Banner of Labor: Institute of Petrochemical Processes imeni Yu. G. Mamedalieyv: Chemistry of petroleum and petrochemical synthesis.

Institute of Inorganic and Physical Chemistry: Physical chemistry, technology of inorganic substances.

Institute of Theoretical Problems of Chemical Technology: Physical chemistry, processes and apparatus of chemical technology.

Institute of Chemistry of Additives: Organic chemistry.

Sector of Radiation Research: Experimental physics.

"Order of Red Banner of Labor" Institute of Physics: Experimental physics.

Institute of Mathematics and Mechanics: Differential and integral equations, mechanics of deformable solids.

Institute of Cybernetics: Mathematical cybernetics, engineering cybernetics and information theory, automated data processing and control systems.

Institute of Geology imeni I. M. Gubkin: Geotectonics.

Institute of Geography: Physical geography, meteorology, climatology and agrometeorology.

Institute of Problems of Deep-Lying Oil and Gas Deposits: Development and exploitation of petroleum, gas and condensed gas deposits.

Institute of Botany imeni V. I. Komarov: Botany, plant physiology.

Institute of Zoology: Hydrobiology.

Institute of Physiology imeni A. I. Karayev: Physiology of man and animals.

Institute of Genetics and Breeding: Biochemistry (one vacancy for the sector of molecular biology and genetics), genetics, breeding and seed growing.

Institute of Soil Science and Agrochemistry: Soil science.

Institute of History: Archeology.

Institute of Architecture and Art: City designing and building, rayon planning, landscaping and rural community planning.

Institute of Economics: Mathematical methods and use of computer technology in economic research, planning and controlling the national economy, political economics.

Institute of Philosophy and Law: Dialectical and historical materialism, philosophical issues of natural science.

Institute of Linguistics imeni I. Nasimi: Turkic languages.

Institute of Literature imeni Nizami: Literature of ethnic groups of the USSR.

Museum of History of Azerbaydzhan: History of the USSR.

Republic Manuscript Archives ["fund"]: Literature of ethnic groups of the USSR.

Part-time enrolment [without dropping work]:

"Order of Red Banner of Labor" Institute of Petrochemical Processes imeni Yu. G. Mamedaliyev: Chemistry of petroleum and petrochemical synthesis, chemical technology of fuel and gas.

Sumgait Branch of "Order of Red Banner of Labor" Institute of Petrochemical Processes imeni Yu. G. Mamedaliyev: Chemistry of high molecular compounds.

Institute of Inorganic and Physical Chemistry: Crystallography and crystallophysics, electrochemistry, colloid chemistry.

Institute of Chemistry of Additives: Chemistry of petroleum and petrochemical synthesis.

Institute of Theoretical Problems of Chemical Technology: Technology of heavy organic synthesis, processes and apparatus of chemical technology.

Sector for Radiation Research: Physical chemistry.

"Order of Red Banner of Labor" Institute of Physics: Experimental physics, theoretical and mathematical physics, physics of semiconductors and dielectrics.

Institute of Mathematics and Mechanics: Function theory and functional analysis.

Institute of Cybernetics: Computer mathematics, mathematical cybernetics, engineering cybernetics and information theory, automated data processing and control systems (in different fields), computer technology, mathematical methods and use of computer technology in economic research, planning and control of the national economy.

Shemakhinskiy Astrophysical Laboratory: Astrophysics.

Institute of Geology imeni I. M. Gubkina: Geophysics, geology of oceans and seas, geochemical methods of detecting deposits of useful minerals, geochemistry, petrography, lithology, mineralogy.

Institute of Geography: Geomorphology and paleogeography.

Institute of Problems of Deep-Lying Oil and Gas Deposits: Development and exploitation of petroleum, gas and condensed gas deposits, drilling oil wells, geology, detection and exploration of oil and gas deposits.

Institute of Botany imeni V. L. Komarov: Botany, physiology of plants, genetics.

Institute of Zoology: Parasitology.

Institute of Physiology imeni A. I. Karayev: Biochemistry, biophysics.

Institute of Genetics and Breeding: Molecular biology (for the sector of molecular biology and genetics), biochemistry (for the sector of molecular biology and genetics), breeding and seed growing.

Institute of Soil Science and Agrochemistry: Soil science, agrochemistry.

Sector for Microbiology: Microbiology.

Institute of History: Archeology, ethnography.

Institute of Literature imeni Nizami: Literature of ethnic groups of the USSR.

Institute of Ethnic Nations of the Near and Central East: History of philosophy, literature of Asian ethnic groups, history of the communist and worker movement, and national liberation movements.

Institute of Philosophy and Law: Scientific atheism.

Institute of Linguistics imeni Nasimi: Turkic languages.

Institute of Economics: Economics, organization of management and planning of the national economy, including different branches of the economy, mathematical methods and use of computer technology in economic research, planning and control of the national economy and its different branches, economics of USSR rayons, distribution of productive forces of the USSR and foreign countries, economics of population and demography, economics and distribution of natural resources.

Institute of Architecture and Art: The fine arts.

Museum of History of Azerbaydzhan: History of the USSR.

Republic Manuscript Archives ["fund"]: Historiography and study of sources.

Enrolment Open for Interdepartmental Graduate Studies--Full-Time:

Institute of Mathematics and Mechanics: Function theory and functional analysis, two vacancies (one at Moscow State University and the other at the Mathematics Institute imeni V. A. Steklov).

Institute of Cybernetics: Differential and integral equations, one vacancy (Leningrad State University, Ministry of VUZ). Technical cybernetics and information theory, one vacancy (Institute of Problems of Information Transmission). Probability theory and mathematical statistics, one vacancy (Moscow State University).

Simgait Branch of "Order of Red Banner of Labor" Institute of Petrochemical Processes imeni Yu. G. Mamedaliyev: Organic chemistry, one vacancy (Moscow State University). Chemistry of high molecular compounds, one vacancy (Institute of Chemical Physics).

Institute of Inorganic and Physical Chemistry: Inorganic chemistry, one vacancy (Institute of General and Inorganic Chemistry imeni N. S. Kurnakova).

Sector for Radiation Research: Optics, one vacancy (Institute of Spectroscopy).

Institute of Geography: Hydrochemistry, one vacancy (Institute of Limnology). Geomorphology and paleogeography, one vacancy (Institute of Geography). Oceanology, one vacancy (Institute of Oceanology imeni P. P. Shirshov). Meteorology, climatology and agrometeorology, one vacancy (Institute of Atmospheric Physics).

Institute of Problems of Deep-Lying, Oil, Gas and Condensed Gas Deposits: Development and exploitation of oil, gas and condensed gas deposits, one vacancy (All-Union Scientific Research Institute of the Petroleum Industry).

Institute of Zoology: Entomology, one vacancy (Leningrad State University, Ministry of VUZ).

Institute of Genetics and Breeding: Genetics, one vacancy (All-Union Scientific Research Institute of Plant Growing). Molecular biology (for the sector of molecular biology and genetics), one vacancy (Institute of Molecular Biology). Biophysics (for the sector of molecular biology and genetics), one vacancy (Institute of Biochemistry).

Institute of Economics: Economics, organization, control and planning of the national economy, one vacancy (Institute of Economics, USSR Academy of Sciences). Mathematical methods and use of computer technology in economic research, planning and control of the national ecoonomy and its branches, one vacancy (TsEMI [expansion unknown], USSR Academy of Sciences).

Institute of Philosophy and Law: Dialectical and historical materialism, one vacancy (Moscow State University). Criminal law and trial law, corrective-labor law, one vacancy (Leningrad State University, Ministry of VUZ). General psychology, one vacancy (Institute of Psychology).

Part-Time Enrolment:

Institute of History: History of the USSR, one vacancy (Institute of Oriental Studies, USSR Academy of Sciences).

* * *

Individuals who have completed their higher education, displayed a capacity for scientific research work and having practical work experience in their chosen specialty of at least 2 years after graduating from a VUZ are eligible for graduate studies. Individuals up to 35 years of age can enroll for full-time graduate studies, and those up to 45 years, for part-time studies.

Young specialists are eligible to participate in competitive tests for acceptance for graduate studies immediately after graduating from a VUZ only when recommended by the councils of VUZ's (faculties). The recommendations are valid from the day of receipt to the end of the current year.

Graduates of correspondence and night schools, with at least 2 years practical work experience in their chosen scientific specialty, may take the entrance examinations for graduate studies right after they graduate from a VUZ.

All individuals enrolling for graduate studies take an entrance examination covering the syllabus of VUZ's in a special discipline, history of the CPSU and one foreign language.

Individuals who have taken all candidatorial examinations are excused from entrance examinations. Those who have passed part of the minimum candidatorial requirement examinations (special subject and foreign language) may, at the discretion of the admitting commission, be excused from the corresponding entrance examinations.

Those who qualify to take the entrance examinations for graduate studies are given a leave for 30 calendar days, with retention of their wages, to prepare and take the tests.

Applications for enrolment for graduate studies are addressed in the name of the director of the scientific research institution of the Azerbaydzhan Academy of Sciences and submitted to the department of personnel and graduate studies of the Azerbaydzhan Academy of Sciences, with one copy of each of the following documents (two copies for individuals referred for special purpose graduate studies): notarized copy of graduation diploma from VUZ (with enclosure), identification form for personnel records with five photographs (10 for those enrolling for special purpose graduate studies), autobiography, reference from the last job, excerpts from the labor book [work record], information about health status with indication of fitness for graduate studies (Form No 286), list of published scientific works, inventions, scientific-technical reports or scientific papers (abstract) in the chosen specialty and review thereof, certification on Form No 6 of having passed the minimum candidatorial requirements stipulated for a given specialty (for those who passed their candidatorial examinations in full or in part), excerpts from the minutes of the meeting of the council for individuals who were recommended for graduate studies immediately after graduation from a VUZ by such councils (faculties).

Individuals enrolled for full-time graduate studies are relieved of their jobs when the studies begin.

Foreigners (unmarried) are provided with dormitory housing.

Applications will be accepted to 25 September and examinations, starting on 1 October.

Total duration of graduate training is 3 years, in the case of full-time students, and 4 years, for part-time ones.

Inquiries should be addressed to the department of personnel and graduate studies, Azerbaydzhan Academy of Sciences, Baku 122, Narimanov Avenue 31 (Academy Town), room 115; telephone number, 37-82-53.

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